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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,166	07/22/2003	Janos Fucsko	MI22-2246	8008
21567	7590	04/18/2005	EXAMINER	
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			KIELIN, ERIK J	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 04/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/625,166	FUCSKO ET AL.	
	Examiner	Art Unit	
	Erik Kielin	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 February 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-64 is/are pending in the application.
- 4a) Of the above claim(s) See Continuation Sheet is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6, 8, 13, 15, 20, 26, 30-32, 34-38, 40, 43, 45, 47, 52, 58 and 62 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>7/22/2003</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of the invention of Group I, the species combination A-1 (oxide), B-1 (ammonium hydroxide), C-1 (ammonium fluoride), D-1 (undoped or elemental silicon) in the replies filed on 11/22/2004 and 2/11/2005 are acknowledged. Applicant indicates that claims 1-8, 13, 15, 16, 20, 26, 30-32, 34-40, 43, 45, 47, 48, 52, 58, and 62 are generic or read on the elected species.

The traversal is on the ground(s) that "Applicant submits that the restriction requirement is inappropriate, and inconsistent with the policies and objectives of the PTO and is inconsistent with an effective and efficient patent system." This is not found persuasive because Applicant admits to having "hundreds of possible 'species.'" (Emphasis in original.) Examiner respectfully submits, the Office policy is to issue valid patents. To ensure that an application that issues is valid, a proper, thorough examination is required. By Applicant's admission of hundreds of possible species, it is virtually impossible to examine all species in the time provided. According to Office policy, then, Examiner must be given sufficient time to properly examine. This is why restriction to a reasonable number of species is required and why Examiner is given authority to make such restriction. Examination of hundreds of species is, in fact, burdensome and accordingly restriction is consistent with Office policy.

The requirement is still deemed proper and is therefore made FINAL.

Claims 63 and 64 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Continuation of Disposition of Claims: Claims withdrawn from consideration are 7,9-12,14,16-19,21-25,27-29,33,39,41,42,44,46,48-51,53-57,59-61,63 and 64.

Art Unit: 2813

Claims 9-12, 14, 17-19, 21-25, 27-29, 33, 41, 42, 44, 46, 49-51, 53-57, and 59-61 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to nonelected species, there being no allowable generic or linking claim.

Moreover, it is noted that Applicant's indication of claims fails to properly read on the elected species. Claims 7 and 39 includes the limitation that the hydroxide is the non-elected, tetramethyl ammonium hydroxide (species B-2) -- the elected species is ammonium hydroxide (species B-1).

Similarly, claims 16 and 48 recite the limitation, "wherein the fluoride comprises an electrolyte with an organic cation." The elected fluoride (C-1) ammonium fluoride is inorganic --not organic-- therefore, a fluoride having an **organic** cation is not generic to the elected species. By contrast, non-elected species C-2, C-3, and C-4 are fluorides having organic cations, as organic compounds are those having carbon bonded to hydrogen (e.g methyl groups).

Accordingly claims 7, 16, 39, and 48 are additionally withdrawn from further consideration as being drawn to non-elected species.

Claim Status

Claims pending: 1-64

Claims withdrawn: 7, 9-12, 14, 16-19, 21-25, 27-29, 33, 39, 41, 42, 44, 46, 48-51, 53-57, 59-61, 63, 64

Claims active: 1-6, 8, 13, 15, 20, 26, 30-32, 34-38, 40, 43, 45, 47, 52, 58, 62

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-6, 8, 13, 15, 20, 26, and 31, 32-38, 40, 43, 45, 47, 52, 58, and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,155,058 (**Fujiwara et al.**) in view of US 5,650,043 (**Kaji et al.**).

Regarding independent claims 1 and 31, **Fujiwara** discloses a method of removing silicon from a substrate, comprising:

depositing a layer comprising undoped silicon in elemental form **107** --as further limited by instant claims 20, 26, 52, and 58-- over a substrate **104** comprising an oxide **105** and a nitride **106**; and

exposing the silicon layer **107** to RIE (reactive ion etching) to remove silicon from the substrate thereby smoothing or flattening the silicon layer **108** (Figs. 6A-7B; col. 5, line 60 to col. 6, line 50).

The elemental silicon is etched selectively relative to the oxide **105** and nitride **106** because neither the oxide **105** nor nitride **106** is etched at all.

Fujiwara does not use the instantly claimed wet etching method.

Kaji teaches that wet etching is better than energy beam irradiation (e.g. RIE) etching for providing the predetermined flatness to a silicon substrate required for fabrication of semiconductor devices (**Kaji**, col. 1, lines 5-19), such as the semiconductor devices in **Fujiwara**.

Art Unit: 2813

Kaji teaches a beneficial solution to the problem is to use an aqueous liquid etching solution comprising ammonium hydroxide and ammonium fluoride --as further limited by instant claims 8, 13, 15, 40, 43, 45, and 47-- and having a pH of greater than 10, under conditions and for a period of time effective to etch the elemental silicon from the substrate to provide an atomically flat surface (Kaji, Abstract; col. 5, line 9 to col. 6, line 3).

Kaji states that the etching solution is manufactured as follows, at **col. 5, lines 9-15**:

“A silicon piece can be etched while keeping the atomic order flatness in an etching solution containing NH_4OH and/or HF in addition to NH_4F . For instance, NH_4F and NH_4OH were mixed together with the ratio of 40% NH_4F : NH_4OH (28% calculated as NH_3)=10:1, and then diluted with pure water so as to adjust the concentration of NH_4F to 0.27M.”

Calculations follow:

As stated above, the molarity of NH_4F is diluted to 0.27M. (Note $M \equiv$ moles/liter solution or mol/L.) Prior to dilution with pure water, the solution is 40% NH_4F and therefore 60% NH_4OH . Therefore the molarity of NH_4OH is $(6/4) 0.27 \text{ M} = 0.405 \text{ M}$. Because in aqueous solution the product of the product of the concentrations of H^+ (as H_3O^+) and OH^- in moles per liter is always 10^{-14} , the pH of the **Fujiwara** exemplary solution is then

$$[\text{H}^+] \cdot [\text{OH}^-] = 10^{-14} \Rightarrow [\text{H}^+] = 10^{-14} / [\text{OH}^-]$$

Because NH_4OH completely dissociates in water, the molarity of OH^- is the same as the molarity of the NH_4OH , which is

$$[\text{OH}^-] = (6/4) \cdot (0.27 \text{ mol } \text{NH}_4\text{OH}/\text{L}) = 0.405 \text{ mol/L}$$

The concentration of $[\text{H}^+]$ is then

$$[\text{H}^+] = 10^{-14} \text{ M}^2 / 0.405 \text{ M} = 2.46 \cdot 10^{-14} \text{ M}$$

Art Unit: 2813

By definition, the $\text{pH} = -\log[\text{H}^+]$; therefore, the pH of the **Fujiwara** solution is -
 $\log(2.46 \cdot 10^{-14}) \approx 13.6$ --as further limited by instant claims 2-4, and 34-36.

The weight of each component, NH_4F , NH_4OH , and H_2O in the final solution is:

$$\text{wt } \text{NH}_4\text{F/L sol'n} = (0.27 \text{ mol } \text{NH}_4\text{F} / \text{L}) \cdot (37 \text{ g } \text{NH}_4\text{F/mol } \text{NH}_4\text{F}) \approx 10 \text{ g } \text{NH}_4\text{F/L sol'n}$$

$$\text{wt } \text{NH}_4\text{OH/L sol'n} = (6/4) \cdot (0.27 \text{ mol } \text{NH}_4\text{OH/L}) \cdot (35 \text{ g } \text{NH}_4\text{OH/mol } \text{NH}_4\text{F}) \approx 14 \text{ g } \text{NH}_4\text{OH/L sol'n}$$

Because water is about 1 g/mL or 1000 g/L, the total amount of NH_4F and NH_4OH is negligible.

Therefore, the weight percent of each of NH_4F and NH_4OH is:

$$\text{wt\% } \text{NH}_4\text{F} = 100 \cdot (10/1000) = 1\% \text{ } \text{NH}_4\text{F}$$

$$\text{wt\% } \text{NH}_4\text{OH} = 100 \cdot (14/1000) = 1.4\% \text{ } \text{NH}_4\text{OH}$$

--as further limited by instant claims 5 and 37.

Further regarding claims 6 and 38, although in the examples provided in **Kaji** do not provide that exact range of 0.01 wt% to 0.5 wt% NH_4F and 0.01 wt% to 1 wt% NH_4OH , these claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious). In the instant case, the instant specification teaches that the broader ranges of 0.01 wt% to 5 wt% NH_4F and 0.01 wt% to 25 wt% NH_4OH work; therefore, there

Art Unit: 2813

exists no evidence of unexpected results for the narrower ranges, which are very close to those disclosed in **Kaji**.

Regarding claims 30 and 62, **Kaji** expressly teaches that the fluoride presence in the etching solution is effective under the conditions to achieve increased uniformity in amount of silicon removal across the substrate than would otherwise occur under identical conditions for the period of time using an identical etching solution but with absence of fluoride in the etching solution (Abstract; col. 2, lines 24-36).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to apply the wet etching method of **Kaji** as the etching method of **Fujiwara**, in order to eliminate the irradiation damage associated with the RIE that **Fujiwara** is using while maintaining atomic flatness necessary for fabrication of semiconductor device, as taught by **Kaji** (**Kaji**, col. 1, lines 5-19; col. 5, line 9 to col. 6, line 3).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 571-272-1693. The examiner can normally be reached from 9:00 - 19:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2813

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Erik Kielin
Primary Examiner
April 16, 2005